the nuclear threads running off from the ends of these segments to the poles of the nuclear spindle, as shown at Fig. 6, *f* and *i*.

These "conjunctive threads," as Fol calls them, arrange themselves in such a manner as to form a double hollow cone with a common base. The segments of the filament then pass out along the line of these threads and gather at the two poles of the spindle. Fig. 5, *a*, and Fig. 8, *b*, show early stages of this transformation, and Fig. 8, *a*, and Fig. 7, *b*, a little later. The new cell-wall or "nuclear plate" is then formed, as shown in Fig. 7, *c*, across these threads at right angles and about midway between the two masses of filaments, the parts of each of which have now united and form a rounded mass, in appearance like the mother-nucleus. The formation of the nuclear plate continues until it reaches across the cell from side to side and forms a complete cell-wall. All these sections are radial longitudinal ones.—*Elmer Sanford.*

ENTOMOLOGY.

Critical Remarks on the Literature of the Organ of Smell in Arthropods.—[The following abstract of the more important portions of Kraepelin's criticisms on the works of writers on the olfactory organs of arthropods, may prove not unwelcome to our entomologists, who may never be able to obtain Kraepelin's rather rare pamphlet. See pp. 889 and 973 of vol. xx.—*A. S. Packard.*]

My own observations on different groups of insects agree, in general, with those of Perris, Forel, and Hauser, without being in a position to confirm or deny the varying relations of the Hemiptera. That irritating odorous substances (chloroform, acetic acid) cause the limbs to move in sympathy with the stimulus, I have seen several times in Acanthosoma; still it may be a gustatory rather than olfactory stimulus.

As regards Crustacea, there are no observations or experiments (except on Asellus) on the conjectural seat of their olfactory organs. It should be here mentioned that Jourdain has described and Professor Dohrn, in Naples, has reported to me that the Brachyura by a remarkable movement of their inner antennæ, which are almost continually in convulsive movements, seem to support the opinion long entertained of the perception of odors by the antennæ.

As to spiders, it is not certainly known whether and to what extent they share in the sense of smell. Robineau-Desvoidy (1842) said that their sense of smell is very well developed and localized in the mandibles, but Perris placed them in the lowest rank of arthropods, though he remarks on "the sensibility of their palpi to smells."

Turning now from speculation and simple observation to exact anatomical and histological data, the nerve-end apparatus seems

to have a distinct reference to the perception of odors. It comprises a structure composed of nervous substances which are enclosed in a chitinous tube, and either only stand in relation to the surrounding bodies by the perforated point, or pass to the surface as free nerve-fibrillæ.

Wolff's theory that the sense of smell is lodged in the skin of the soft palate-like roof of the mouth is published in a work of two hundred and fifty quarto pages, which shows so much skill, acuteness, and subtle reasoning that his views prevailed for several years, and were adopted by Graber in his well-known work on insects. Forel appears to have been the first to oppose Wolff's conclusions, both on theoretical grounds and from his experiments on Polistes and Sphex. Leydig, in his work on Amphipoda and Isopoda (p. 235), expresses the view that "this nasal skin possesses nothing more special than other regions of the skin which should be considered as tactile." I think that Leydig is here perfectly correct, and that those small pit-hairs are plainly tactile organs, since such must be present in the mouth near the organs of taste. Moreover, it is generally doubtful whether such direct sense-perceptions as smell and taste can pass through chitinous membranes; a perforation of their terminations has never been observed in the hairs under consideration. Hence the analogously formed hairs in the suctorial canal of the dipterous labrum [hypopharynx] in their whole arrangement (they stand in two longitudinal rows like the trees on each side of an alley) show that they are formed to feel and repel solid bodies, rather than to smell them. The presence of a gland differing in the nature of its secretion from the other glands of the mouth, on which Wolff laid so great weight, should not have much force as an argument, since we know as good as nothing of the chemistry of digestion and the secretions in insects necessary for it. The apparatus is better fitted by its situation for a gustatory apparatus. Hence we should adopt Leydig's view of the tactile nature of these minute hairs so long as no further anatomical and physiological data prove their gustatory function.

In insects there is a remarkable and fundamental difference in the structures of the parts supposed to be the organs of smell. Erichson (10) was acquainted only with the "pori" covered by a thin membrane; but Burmeister (11), in his careful work on the antennæ of the lamellicorns, distinguished pits at the bottom of which hairs rise from a glass-like tubercle, from those which were free from hairs. Leydig (14) afterwards was the first to regard as olfactory organs the so-called pegs (kegel), a short, thick hair-like structure distinctly perforated at the tip, which had already by Lespès (38) in Cercopsis, etc., been described as a kind of tactile papilla. Other very peculiar olfactory organs of different form Forel (Fourmis de la Suisse) discovered in the antennæ of ants, which Lubbock ("On some points," etc.), according to a short

notice of Forel, incorrectly associated with the nerve-end apparatus found by Hicks in other insects. This manifold nature of the antennal organs has by the last investigator, Hauser (22), from thorough studies of the nerve-elements belonging to them, been not simplified but rendered more complicated. According to this naturalist we may distinguish the following forms which the olfactory organs may assume: 1. Pale, tooth-like chitinous hairs on the outer surface of the antennæ, which are perforated at the end; nothing is known as to the relation of the nerve passing into it (Chrysopa, Anophthalmus). 2. In pit-like depressions of the antennæ arise *nerve-rods* (without a chitinous case) which stand in direct relation with a ganglion-cell lying under it. These pits are either *simple*, viz., with only an "olfactory rod" (Tabanus and other Diptera, Vanessa), or *compound* (Muscidæ and most other Diptera, and Philonthus). It seems important that these pits are partly *open* (in the above-named groups of insects), and partly *closed* and covered with a thin membrane, under whose concavity the olfactory rods end (Orthoptera, Melolontha, and other lamellicorns). 3. Short, thick pits sunken slightly into the surface of the antennæ, and over this a chitinous peg perforated at the end, in whose base, from the interior, projects a very singular *nerve-peg*, which is situated over an olfactory ganglion-cell, and provided with a slender *crown of little rods*, and flanked on each side by a flagellum-cell (Hymenoptera). 4. Round or crevice-like pits covered over by a perforated chitinous membrane with nerve-rods like those in 3, but in place of the flagellum-cell with "membrane-forming" cells spread before it. Hauser finally mentions further differences in the ganglion-cells sent out into the nerve-end apparatus. These exhibit in Diptera and Melolontha only one nucleus, in Hymenoptera a single very large one (with many nucleoli) and three small ones, in Vanessa six, in Orthoptera a very large number of nuclei, etc. We add beside all these different forms also the Forelian flasks ("microscopical stethoscopes" of Lubbock) not known to Hauser, and the champagne-cork organ in ants; thus we have in fact a very great variety, so that it seems difficult to understand how Hauser could nevertheless ascribe a common function to all these nerve-end apparatuses.

As the final result of my researches I may state *that the great variety of antennal structures previously described may be referred to a single common fundamental type of a more or less developed free or sunken hair-like body which stands in connection by means of a wide pore-canal with a many-nucleated ganglion-cell.*[1] *The latter sends only a relatively slender nerve-fibre (axial cord) through*

[1] Perhaps this structure might more correctly be considered as a ganglion with numerous cells, since in fact the whole structure of the nerve-mass, namely, in the Hymenoptera, has a great similarity with that of the crustacean antenna.

the pore-canal into the hair; but the same is enclosed by epithelial cells which surround the pore-canal.

Kraepelin thus sums up our present knowledge of the olfactory organs of Coleoptera: *The terminal apparatus of the organ of sense in the antennæ of beetles consists in each case of a chitinous, delicate or thick, long or short hair-like structure, which is planted in the middle of a more or less arched, "dome-like membrane" closing in the wide pore-canal of the antennal wall. This membrane extends over the pore-canal at the same level as the surface of the antennal integument* (Geotrupes, Strangalia), *or it rises as a cupola in the middle of a beaker-shaped pit* (Melolontha, Buprestidæ, Dytiscidæ). *Often such sense-organs (either with or without special pits) are so united that they stand associated in flat depressions of the surface of the antennæ, the so-called "compound" pits* (Melolontha, Strangalia, Euchroma, Lucanus, etc.).—*K. Kraepelin.*

ZOOLOGY.

Mimicry in Amphipods.—Dr. Carl Bovallius describes (*Nova Acta Reg. Soc. Sci. Upsaliensis*, xviii., 1886) a new genus of Hyperid Amphipods, the three species of which are remarkable for their mimicry of jelly-fishes. The head and five, six, or all seven of the thoracic segments are enormously inflated, so that the anterior part of the body closely resembles the bell of a medusa, while the feet and compressed abdomen hang down like the tentacles of the mimicked form. For these forms the generic name Mimonectes is proposed, and even a new family has to be instituted. Among the other more remarkable characters are the following: The eyes "do not form a continuous mass on each side of the head as in the other Hyperids, but consist of six to ten large ocelli scattered over the lower side of the head. These do not show such long crystallic [*sic*] elements as in Phronima, Rhabdosoma, and others, but seem to be composed each of a great many granular, fine, light-breaking corpuscles interspersed with dark brown pigment." The innervation of these ocelli is peculiar; some receive their nerve-supply directly from the brain, while in others the filaments seem to arise from the œsophageal commissures. Whether this is actually the case or not remains to be determined by sections of fresh specimens, but it is interesting to note that all the ocellar nerves (except two) arise *behind* the nerves supplying the antennæ. The "bell" of the animal is filled with a liquid enclosed by a thin pellucid membrane, but as all the material was alcoholic, the nature of the fluid could not be ascertained. The alimentary canal showed no traces of cæca or hepatic glands. The three species are *Mimonectes lovêni*, from the Atlantic; *M. sphæricus*, from near the Canary Isles; and *M. steenstrupii*, from the mouth of Davis Strait.